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Is the good-imitator-poor-talker profile syndrome-specific in Down syndrome?: Evidence from standardised imitation and language measures

M. Vanvuchelen [a,b,c,*], H. Feys [c], W. De Weerdt [c]

[a] Department Health Care, PHL University College, Belgium
[b] Department of Rehabilitation Sciences, V.U.B., Belgium
[c] Department of Rehabilitation Sciences, K.U. Leuven, Belgium

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A B S T R A C T

The emergence of the Down syndrome (DS) behavioural phenotype during early development may be of great importance for early intervention. The main goal of this study was to investigate the good-imitator-poor-talker developmental profile in DS at preschool age. Twenty children with Down syndrome (DS; mean nonverbal mental age NMA 1 y10 m) and 15 children with non-specific mental retardation (NS-MR; mean NMA 1 y11 m) participated in this study. The Preschool Imitation and Praxis Scale (PIPS) and the Dutch version of the MacArthur–Bates Communicative Development Inventories (N-CDI) were used to determine absolute and relative (contrasted to a nonverbal mental age reference) imitation and language abilities. Results revealed that there was clear evidence for a good-imitator-poor-talker profile in preschoolers with DS. However, only the advanced bodily imitation ability seems to be syndrome-specific. Clinical implications of these findings are considered.

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1. Introduction

The similar sequence or similar structure hypothesis states that children with non-specific intellectual disability (ID) would not, as a group, show any particular areas of strength or weakness compared to mental age matched children (Weisz & Zigler, 1979). In contrast, similar structures have not held up particularly well for mentally retarded children with specific genetic syndromes. Recent progress has occurred in measuring behavioural phenotypes or the ways in which different genetic syndromes predispose children to show specific developmental profiles or trajectories, as well as in connecting behavioural phenotypes to regions of the brain or the genome (Schaer & Eliez, 2007). The most unambiguous definition of phenotypes requires that a distinct developmental profile occurs in almost every case of the genetic disorder, and rarely in other conditions. In a less stringent definition, a behavioural phenotype should involve the heightened probability that people with a given syndrome will exhibit certain behavioural and developmental characteristics relative to those without the syndrome (Hodapp & Dykens, 2005). For this purpose, the sensitivity and specificity of each strength and weakness of people with a given syndrome should be determined. Sensitivity refers to the universality criterion and specificity to the uniqueness criterion of a characteristic. Rather than simply stating that a characteristic is or is not universal or unique, reporting rates of sensitivity and specificity gives a sense on how the characteristic represents individuals with a particular

* Corresponding author at: Sterrebos 111, B 3512 Stevoort, Belgium. Tel.: +32 11274124.
E-mail addresses: MVanvuchelen@mail.phl.be, Marleen.Vanvuchelen@faber.kuleuven.be (M. Vanvuchelen).

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syndrome (Mervis & Robinson, 1999). From a pedagogical perspective, knowing which developmental profile is syndrome-specific and which is common to all persons with mental retardation may be essential to consider when selecting educational and intervention techniques (Fidler & Nadel, 2007).

Pivotal human abilities to consider when studying developmental profiles in children with ID, are motor imitation (hereafter ''imitation'') and language. One benefit of these nonverbal and verbal capacities is the aptitude to learn about the world, indirectly, from others and thus profit from each other's experiences. The imitation of others is widely recognised as a behaviour which is especially crucial to learning in the early years. It underpins both the development of relationships with others and socially based learning (Hurley & Chater, 2005). Imitation is founded on a perception-action coupling mechanism to match the visual kinematic features of a perceived action to the motor kinematic features of the own action (Prinz, 2002). This visual-motor ability starts long before children develop language, and is even evident very soon after birth in typically developing infants (Meltzoff & Moore, 1977) and in infants with Down syndrome (Heimann, Ullstadius, & Swerlander, 1998; Heimann & Ullstadius, 1999).

2. Down syndrome

Down syndrome (DS) is the most prevalent cause of ID associated with a genetic anomaly, in this case, trisomy of chromosome 21. The increased protein expression of genes on chromosome 21 leads to a cascade of effects in the development of fetal brain structure and subsequent structural and behavioural effects across the life span of individuals with DS. It affects both physical and cognitive development and produces a characteristic phenotype. Mental retardation remains the most salient feature of persons with DS. All people with DS, without exception, have a low IQ, although there is unanimous agreement that there is high inter-individual variability. The average IQ score for DS persons is around 50, with individual values ranging from 30 to 70 (Chapman & Hesketh, 2000).

While performance in most areas can be predicted based upon overall intellectual disability in persons with DS, relative weaknesses were consistently found to be associated with morphosyntax, verbal short-term and explicit long-term memory functions. In contrast, relative strengths were found to be associated with visual-motor skills, associative learning, social-emotional functioning, visuospatial short-term and implicit long-term memory functions (Dykens, Hodapp, & Evans, 2006; Fidler, Hepburn, & Rogers, 2006; Hodapp & Dykens, 2005; Kasari & Freeman, 2001; Schaer & Eliez, 2007; Wang & Bellugi, 1994; Wang, 1996). This fact was first documented in 1982 by the research group of Silverstein. They analysed Stanford–Binet IQ results from 377 institutionalised persons with DS 4–56 years old, and age- and IQ-matched persons with non-specific mental retardation. They found that persons with DS performed worse on five test items requiring verbal responses and better on four items requiring visual-motor skills (Silverstein et al., 1982, cited in Wang, 1996).

Language is among the most impaired domains of functioning in DS and perhaps, also the greatest barrier to independent meaningful inclusion in the community (Abbeduto, Warren, & Conners, 2007). Individuals with DS have language deficits, particularly in expressive language and poor speech intelligibility relative to receptive language abilities (see for recent reviews: Abbeduto et al., 2007; Martin, Klusek, Estigarribia, & Roberts, 2009; Roberts, Price, & Malkin, 2007). Despite these difficulties, young children with DS interact reasonably well with the surrounding environment. Delays in language development in these children are complemented by an emerging relative strength in visual-motor (Wang, 1996) and social-emotional functioning (Fidler et al., 2006). Down himself drew attention to the ability of children with DS to imitate others, and indeed a number of studies suggest that imitation may be a characteristic strength in DS (Dykens & Hodapp, 2001; Libby, Powell, Messer, & Jordan, 1997; Rast & Meltzoff, 1995; Wright, Lewis, & Collis, 2006).

Despite the common assumption that children with DS have a predisposition for being good imitators, this assumption was never tested with the use of a standardised imitation measure. In addition, data are scarce on how DS children's good-imitator-poor-talker profile is syndrome-specific.

3. Objectives of this study

The main goal of this study was to investigate the good-imitator-poor-talker developmental profile in DS at preschool age and to examine how it contrasts to peers with non-specific mental retardation. Two questions were addressed in this study. First, can the common assumed good-imitator-poor-talker profile in DS be confirmed at preschool age with the use of standardised measures? This question was addressed with a cross-domain approach and within-group analyses. Secondly, we investigated if this developmental profile was syndrome-specific. This question was addressed with a cross-diagnosis approach and between-group analyses.

We highlighted four key aspects of our approach. First, standardised measurement tools, the Preschool Imitation and Praxis Scale (PIPS) (Vanvuchelen, Roeyers, & De Weerdt, 2010a) and the Dutch version of the MacArthur–Bates Communicative Development Inventory (N-CDI) (Zink & Lejaegere, 2002) were implemented. These tools provide age-equivalent scores for imitation, respectively language aptitude. Age-equivalent scores are used to verify the absolute imitation and language level of performance. This approach allows determining whether children with DS have spared imitation and language functions. By definition, a spared function implies that the children perform at the same level as typically developing children of the same chronological age. We also compared the children's absolute score on one domain of functioning to the absolute score on another domain using a within-group analysis. This cross-domain approach allows for determining whether an ability reflects an absolute strength or absolute weakness relative to another ability.

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Second, we calculated delay scores, i.e. difference scores between imitation and language age-equivalent scores and the child's nonverbal mental age. This approach allows determining whether an ability is a relative strength (i.e. performance that is above the nonverbal mental age), at expected level (i.e. performance that is appropriate given the nonverbal mental age) or a relative weakness (i.e. performance that is below the nonverbal mental age). This approach allows ruling out mental impairment as the cause of imitation and language problems in the target group under study. We determined the sensitivity rate of each relative strength and relative weakness.

Third, comparisons to a group of children with non-specific mental retardation (NS-MR) exposed whether a strength or weakness characterised children with mental retardation in general or, instead, the target group of children with DS. We determined the specificity rate of each relative strength and weakness.

Finally, we determined how similar the groups were in socioeconomic status (SES). We also determined possible gender effects within each group.

4. Methods

4.1. Participants

All families gave written informed consent for the participation of their child.

4.1.1. Participants with Down syndrome (DS, n = 20)

Twenty children with DS (12 female and 8 male) between 13 and 56 months of age (mean chronological age CA 38.2 m, SD 9.5 m) with a nonverbal mental age (NMA) between 8 and 39 months (mean NMA 22.3 m, SD 7.3 m) were recruited from home-based child development programs for children with mental disabilities.

4.1.2. Participants with non-specific mental retardation (NS-MR, n = 15)

Fifteen children with NS-MR (5 female and 10 male) between 34 and 58 months of age (mean CA 46.0 m, SD 8.0 m) with a NMA between 12 and 35 months (mean NMA 23.4, SD 5.8 m) were recruited from special schools for children with learning disabilities.

4.2. Measures

4.2.1. Measurements of nonverbal mental level

The Dutch modification of the nonverbal version of mental scale of the Bayley Scales of Infant Development (BSID-II-NL; Van der Meulen, Ruiter, Lutje Spelberg, & Smrkovsky, 2000) was used to determine the children's developmental index and nonverbal mental age.

4.2.2. Preschool Imitation and Praxis Scale (PIPS)

The Preschool Imitation and Praxis Scale (PIPS) is a multidimensional imitation test to investigate bodily (gestural and facial) and procedural (actions with objects) imitation in children between 12 and 59 months of age. To construct the PIPS, action types with different effects (salient environmental and internal), representational levels (meaningful, and non-meaningful; goal directed and non-goal directed), temporal complexities (single and sequential) and visual monitoring possibilities (transparent and opaque) were chosen to tap the full range of possible imitation mechanisms. Imitation tasks which are possible to be performed by young children but unlikely to be exhibited spontaneously were selected (Vanvuchelen et al., 2010a). Non-imitative behaviour with the objects used in the PIPS was ruled out. The ten task categories (six gestural, one facial and three procedural) and 30 PIPS tasks (three for each task category) have been described in detail elsewhere (Vanvuchelen et al., 2010a, 2010b, in press).

Imitation performances on each task evaluate the spatiotemporal resemblance between the modelled and copied action on a 3–5 point scale (Vanvuchelen, 2009). To illustrate this system, we exemplify the scoring of the task "to pretend to comb your hair with an imaginary comb". Score 4 is given if the child has used a symbolic grip and has performed a repetitive action on both sides of the head. Score 3 is given if the child has used a symbolic grip and has performed a repetitive action on one side of the head or a single action. Score 2 is given if the child has used a body-part-as-an-object grip and has performed a repetitive action on both sides of the head. Score 1 is given if the child has used a body-part-as-an-object grip and has performed a repetitive action on one side of the head or a single action. Score 0 is given is the child has performed another action or has refused to imitate. The total PIPS score ranges between zero and 81 and is a reflection of the accuracy of the child's imitation performance (Vanvuchelen, 2009). Intrarater and interrater reliability of the PIPS items and the total score have been established. Results of test-retest analysis indicated that the PIPS score is stable over time (Vanvuchelen et al., in press). Bodily and procedural imitation age-equivalents were derived from PIPS scores of 654 typically developing children between 12 and 59 months of age (Vanvuchelen, 2009).

For the test administration, the children were assessed by two trained examiners. Each child was individually assessed in a quiet room and was seated at a table in front of the examiner. Before administering the 30 tasks of the PIPS, a child was given three exercises: the imitation of 'removing five beads one by one from a string and putting them in a cup'; 'clapping the hands', and 'raising an open hand'. During these introductory tasks, a broad range of instructions to evoke imitation was

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given to the child: demonstrations, verbal commands, physical assistance. The 30 tasks of the PIPS were presented in a standardized way, e.g. left and right handed actions were demonstrated alternately. The child was free to imitate with the left or right hand. Before demonstrating each task, the child's attention was attracted by addressing the child by name. During the test, only the verbal instruction "(Name), you do this too" was given.

4.2.3. *Measurements of receptive and expressive language level*

Language reception and expression level was measured using the Dutch version of the MacArthur–Bates Communicative Development Inventories N-CDIs (Zink & Lejaegere, 2002). The MacArthur Communicative Development Inventories (CDIs) are a pair of widely used parent-report instruments for assessing children's early language skills (Fenson et al., 1993).

4.2.4. *Socio-economic status (SES)*

The SES of the children was determined by the educational level of their mother expressed in educational years: level 1 (less than 7 years), level 2 (7–10 years), level 3 (11–12 years), level 4 (13–16 years) and level 5 (more than 16 years).

4.3. *Data-analysis*

All analyses have been performed using the statistical software SPSS (version 16.0). p-Values smaller than 0.05 were considered as significant.

4.3.1. *Descriptive statistics and preliminary analyses*

Differences between the two groups regarding chronological age, developmental index and nonverbal mental age were verified with the Mann–Whitney U test (U).

4.3.2. *Spared imitation and language development*

Within-group differences regarding chronological age and imitation, respectively language age-equivalent scores were verified with the Wilcoxon signed ranks test (Z). A group is considered to have spared imitation, respectively language functions if the age-equivalent scores are not significantly different from the chronological age. We have determined the average scores (group level) as well as the number of children in each group (individual level) with a spared imitation, respectively language development.

4.3.3. *Absolute strengths and weaknesses in imitation and language*

Within-group differences regarding bodily and procedural imitation, receptive and expressive language age-equivalent scores were verified with the Wilcoxon signed ranks test (Z). This criterion reflects the requirement that an absolute strength or weakness in a particular ability be present relative to another ability.

4.3.4. *Relative strengths and weaknesses in imitation and language*

To take into account nonverbal mental age, all scores (i.e. bodily and procedural imitation, receptive and expressive language) are expressed as a difference between age-equivalent scores and nonverbal mental age at the moment the specific tests are performed. As such, a child having a score which corresponds with his/her nonverbal mental age will have a zero (difference) score. A positive score pertains to advancement in relation to the child's nonverbal mental age. A negative score pertains to delay in relation to the child's nonverbal mental age.

Differences between the two groups regarding imitation and language delay scores were verified with the Mann–Whitney U test (U).

Within-group differences regarding nonverbal mental age and imitation, respectively language age-equivalent scores were verified with the Wilcoxon signed ranks test (Z). A child was considered to be a relative good or poor imitator if imitation age-equivalent scores were significantly different from nonverbal mental age. Similarly, a child was considered to be a relative good or poor talker if language age-equivalent scores were significantly different from nonverbal mental age. This criterion reflects the requirement that a relative strength or weakness in a particular ability be present regardless of the overall level of functioning. We have determined the average scores (group level) as well as the proportion of children (individual level) in each group with relative strengths or weaknesses in imitation and language development.

If a relative strength or weakness in imitation or language was revealed, sensitivity and specificity scores were calculated. Sensitivity is defined as the proportion of individuals in the target diagnostic group who display the characteristic. Specificity is defined as the proportion of individuals without the target diagnosis who do not possess the characteristic.

4.3.5. *Analyses of SES and gender effects*

Differences between SES of DS and NS-MR participants were verified with the Mann–Whitney U test (U). Differences between chronological age, nonverbal mental age and delay scores of female and male participants were calculated using the Mann–Whitney U test (U).

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5. Results

5.1. Descriptive statistics and preliminary analyses

Table 1 gives an overview of descriptive information for chronological age, developmental index and nonverbal mental age, as well as imitation and language delay scores for the DS ($n = 20$) and NS-MR ($n = 15$) participants.

The children with DS were significantly younger and had a significantly higher developmental index than the children with NS-MR. The two groups did not differ significantly in nonverbal mental age. For that reason, nonverbal mental age was introduced as reference criterion to compare the imitation and language delay scores of both groups.

5.2. Spared imitation and language development

Within-group differences regarding chronological age and age-equivalent scores were verified. In the DS group there was clear evidence ($p < 0.001$ for all comparisons, Z-scores are not shown) that bodily and procedural imitation age (25.3 m and 23.2 m, respectively) as well as receptive and expressive language age (17.7 m and 15.8 m, respectively) were below the children's chronological age of 38.2 m. Analyses on individual child level revealed that one girl with DS of 13 months of age had a bodily imitation age of 16 months, suggesting a spared bodily imitation development. There were no children in the DS group with a spared procedural imitation, receptive and expressive language development.

In the NS-M group there was clear evidence ($p < 0.001$ for all comparisons, Z-scores are not shown) that bodily and procedural imitation age (23.2 m and 22.9 m, respectively) as well as receptive and expressive language age (17.6 m and 18.0 m, respectively) were below the children's chronological age of 46.0 m. There were no children in the NS-MR group with a spared bodily and procedural imitation, receptive and expressive language development.

5.3. Absolute strengths and weaknesses in imitation and language

Within-group differences regarding age-equivalent scores were verified. The asterisks on the horizontal lines in Fig. 1 depict the significant differences between imitation and language age-equivalent scores for children with DS and NS-MR separately (Fig. 1).

In the DS group, there was clear evidence for an absolute strength in bodily imitation compared to receptive ($Z = -3.6$; $p < 0.001$) and expressive language ($Z = -3.9$; $p < 0.001$), but not to procedural imitation ($Z = -0.7$; $p = 0.44$). There was also clear evidence for an absolute strength in procedural imitation compared to receptive ($Z = -3.3$; $p = 0.001$) and expressive language ($Z = -3.6$; $p < 0.001$). The receptive language age of the children with DS was significantly higher than the expressive language age ($Z = -3.7$; $p < 0.001$).

In the NS-MR group, there was clear evidence for an absolute strength in bodily imitation compared to receptive ($Z = -2.7$; $p = 0.006$) and expressive language ($Z = -2.4$; $p = 0.01$), but not to procedural imitation ($Z = -0.5$; $p = 0.55$). The procedural imitation age-equivalent score was somewhat higher than the receptive language and expressive age-equivalent scores, but the differences were not significant ($Z = -1.7$; $p = 0.07$; respectively, $Z = -1.6$; $p = 0.10$). There was no evidence for a difference between receptive language and expressive language age-equivalent scores ($Z = -0.6$; $p = 0.52$).

Table 1
Descriptive information of baseline characteristics and delay scores (mean, standard deviation) for children with Down syndrome (DS) and non-specific mental retardation (NS-MR).

	DS ($n = 20$)	NS-MR ($n = 15$)	U	p-Value
Baseline characteristics				
Chronological age (CA), months	38.2 (9.5)	46.0 (8.0)	81.0	0.02
Developmental index	58.3 (9.6)	51.1 (11.0)	82.5	0.02
Nonverbal mental age (NMA), months	22.3 (7.3)	23.4 (5.8)	128.0	0.46
Delay scores in relation to NMA				
Bodily imitation delay (BID), months	2.9 (4.8)[a] ↑	−0.2 (6.8)[b]	109.0	0.17
Procedural imitation delay (PID), months	2.5 (7.6)[c]	−0.5 (9.6)[c]	114.0	0.24
Receptive language delay (RLD), months	−3.7 (4.8)[d] ↓	−5.0 (3.7)[d] ↓	129.0	0.49
Expressive language delay (ELD), months	−6.7 (5.7)[e] ↓	−4.6 (4.2)[e] ↓	121.0	0.34

Negative values for the scores refer to a delay with respect to non-verbal mental age. In the remainder, both the negative (relative weaknesses) and the positive (relative strengths) difference scores are referred to as delay scores. U, Mann–Whitney U test.
↑Age-equivalent significant above nonverbal mental age.
↓Age-equivalent significant below nonverbal mental age.
[a] Bodily imitation age of this diagnostic group is significantly above nonverbal mental age ($p = 0.03$).
[b] Bodily imitation age of this diagnostic group is not significantly different from nonverbal mental age ($p > 0.05$).
[c] Procedural imitation age of this diagnostic group is not significantly different from nonverbal mental age ($p > 0.05$).
[d] Receptive language age of this diagnostic group is significantly below the nonverbal mental age ($p < 0.01$).
[e] Expressive language age of this diagnostic group is significantly below nonverbal mental age ($p < 0.01$).

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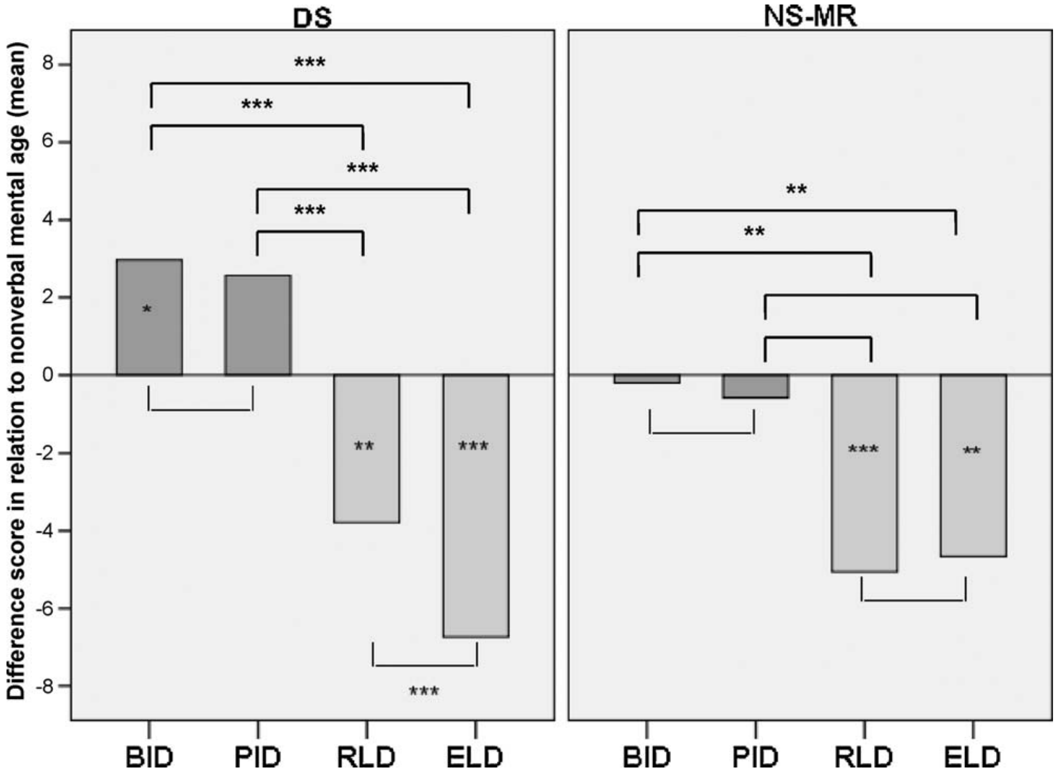

Fig. 1. Bar charts of bodily (BID) and procedural imitation delay (PID), receptive (RLD) and expressive language delay (ELD) scores (i.e. differences between nonverbal mental age and age-equivalents scores) of preschoolers with Down syndrome (DS; $n = 20$) and non-specific mental retardation (NS-MS; $n = 15$). Note that both the negative (relative weaknesses) and the positive (relative strengths) difference scores are referred to as delay scores. The asterisks on the horizontal lines depict the significant differences between imitation and language age-equivalent scores. The asterisks within the bars represent the significant differences between nonverbal mental age and imitation and language age-equivalent scores, respectively. $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

5.4. Relative strengths and weaknesses in imitation and language

Between group analyses revealed that both groups did not differ significantly in bodily and procedural imitation, receptive and expressive language delay scores (see Table 1).

Within-group differences regarding nonverbal mental age (NMA) and imitation, respectively, language age-equivalent scores were verified. Fig. 1 graphs the imitation and language delay scores in the two groups separately. The asterisks within the bars depict the significant differences between NMA and imitation and language age-equivalent scores.

There was clear evidence in the DS group for an advanced bodily imitation development in relation to NMA ($Z = -2.1$; $p = 0.03$). Children with DS should be considered as good-imitators relative to their nonverbal mental age expectancy, at least with respect to bodily imitation. Analyses on individual child level revealed that in 13/20 children with DS bodily imitation age was above their NMA, which means a rate of sensitivity of 0.65. In the NS-MR group, 8/15 children did not possess this relative strength, which means a specificity rate of 0.53. Although the procedural imitation age of children with DS was slightly above NMA, this difference was not significant ($Z = -1.3$; $p = 0.16$). In the DS group, there was clear evidence for receptive ($Z = -2.8$; $p = 0.005$) and expressive language delay ($Z = -3.8$; $p < 0.001$) in relation to the children's NMA. Results revealed that children with DS should be considered as poor talkers relative to their nonverbal mental age expectancy. Analyses on individual child level revealed that 15/20 children with DS understood and 19/20 spoke language below their NMA, which means a rate of sensitivity of 0.75, respectively, 0.95. However, results of the group with NS-MR revealed that the specificity of these relative weaknesses was extreme low: zero, respectively 0.13.

In the NS-MR group, both bodily imitation age ($Z = -0.1$; $p = 0.86$) and procedural imitation age ($Z = -2.8$; $p = 0.77$) were not significantly different from NMA. There was clear evidence for a receptive ($Z = -3.4$; $p = 0.001$) and expressive language delay ($Z = -3.0$; $p = 0.002$) in relation to the children's NMA. Children with NS-MR should be considered as poor talkers relative to their nonverbal mental age expectancy. Analyses on individual child level revealed that all children with NS-MR understood and 13/15 spoke language below their NMA, which means a rate of sensitivity of 1.0, respectively, 0.87. The specificity rates of these relative weaknesses were low: 0.25, respectively, 0.05.

5.5. Analyses of SES and gender effects

The distribution of the SES scores of children with DS was as follows: one child with score 1; eight children with score 3; six children with score 4 and five children with score 5. The distribution of the SES scores of children with NS-MR was as

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follows: five children with score 2; seven children with score 3; two children with score 4 and one child with score 5. The SES of children with DS was significantly higher than the SES of children with NS-MR ($U = 81.5$, $p = 0.02$).

In the DS group, there was no evidence of gender differences in chronological age ($U = 38.0$; $p = 0.43$), nonverbal mental age ($U = 30.0$; $p = 0.16$), bodily imitation ($U = 46.0$; $p = 0.87$), procedural imitation ($U = 44.0$; $p = 0.75$), receptive language ($U = 45.0$; $p = 0.81$) and expressive language delay scores ($U = 47.0$; $p = 0.93$). The same was true in the NS-MR group for chronological age ($U = 21.0$; $p = 0.62$), nonverbal mental age ($U = 19.0$; $p = 0.46$), bodily imitation ($U = 16.0$; $p = 0.31$), procedural imitation ($U = 12.0$; $p = 0.12$), receptive language ($U = 24.0$; $p = 0.90$) and expressive language delay scores ($U = 19.0$; $p = 0.46$).

6. Discussion

Imitation and language are two developmental domains, which play a central role in the acquisition of daily living skills and in the general adjustment and adaptive behaviour of young children. Although the Down syndrome (DS) behavioural phenotype has been described as involving strengths in imitation and weaknesses in language development, the emergence of this phenotypic pattern in a sample of preschoolers with DS has not yet been fully explored. This study is the first to investigate in a systematic way imitation and language aptitude of preschoolers with DS contrasted to preschoolers with non-specific mental retardation (NS-MR) with the use of standardised tests.

At first sight, results of present study confirm that the behavioural phenotype in DS at preschool age follows the characteristic pattern of good-imitator and poor-talker. The children's bodily and procedural imitation development was significantly more advanced than their receptive and expressive language development. However the same pattern was found in preschoolers with NS-MR. This finding indicates that an absolute strength in imitation and an absolute weakness in language abilities characterise preschoolers with ID in general rather than preschoolers with DS only.

To rule out mental impairment as the cause of imitation and language problems, we calculated delay scores, i.e. difference scores between imitation and language age-equivalent scores and the children's nonverbal mental age. Relative imitation and language strengths and weaknesses were defined as an age-equivalent score above, respectively, below the expectation based on the children's nonverbal mental age. Preschoolers with DS imitated gestures and facial expressions, commonly termed as bodily imitation, at a level surpassing nonverbal mental age expectations. Therefore, this advanced bodily imitation aptitude can be considered as a relative strength in DS at preschool age. Moreover, this bodily imitation strength can be considered as syndrome-specific in DS. This characteristic was not found in peers with NS-MR as a group. Since only 65 percent of the DS children were characterised with a bodily imitation strength, this developmental feature can be considered as a less stringent behavioural phenotype. Still, the finding of an imitation strength is striking, since another aspect of the DS behavioural phenotype involves difficulties with motor (Fidler et al., 2006; Vicari, 2006) and praxis skills (Fidler, Hepburn, Mankin, & Rogers, 2005). Furthermore, whether and how well children imitate depends to some extent on their prior experience with the demonstrated actions. Results of neuroimaging studies indicate that activation of cortical areas involved in movement observation depends on learned expertise in performing the observed movements, e.g. in crawling and walking infants (van Elk, van Schie, Hunnius, Vesper, & Bekkering, 2008). Although in the present study the children with DS were significantly younger than the children with NS-MR and therefore had less experience with the demonstrated meaningful and goal-directed actions of the PIPS, they imitated at the same level as the children with NS-MR.

In contrast with the relative good imitation abilities, children with DS were relative poor talkers. In our sample, 75 percent of preschoolers with DS understood and 95 percent spoke below the expectation based on their nonverbal mental abilities. Although the relative language weakness had an acceptable sensitivity rate, this developmental feature cannot be considered as a behavioural phenotype. All the children with NS-MR understood and 87 percent spoke below mental age expectancy. This finding indicates that a relative language weakness is not syndrome-specific. As such, these data are in contrast to the similar structure hypothesis, which states that persons with NS-MR do not show as a group any particular areas of strength or weakness (Weisz & Zigler, 1979). Our finding that preschoolers with DS have an expressive language deficit relative to receptive language abilities is consistent with previous studies (Abbeduto et al., 2007; Martin et al., 2009; Roberts et al., 2007).

The profile of relative strength of imitation skills and weakness of language skills in DS may be linked to findings from brain imaging studies. Based on MRI data, the parietal lobe of DS persons is relatively preserved. This may be related to the relative strengths in visual-motor tasks, such as imitation, seen in many individuals with DS. At the same time, persons with DS have reduced proportional size of the frontal lobe and structural changes in the temporal lobe regions, which may be implicated in the difficulties many persons with DS have with language and auditory short-term memory (Dykens & Hodapp, 2001; Schaer & Eliez, 2007).

Another finding of the present study was that the mothers of children with DS were of higher SES than the mothers of children with NS-MR. Advanced maternal age is the most significant risk factor for non-disjunction of chromosome 21. For that reason, mothers of children with DS are more likely to be older and to have spent more years in education, and thus to be of higher SES than mothers of children with NS-MR (Dykens & Hodapp, 2001).

A strong point of this study was the young age group. Syndrome-related strengths and weaknesses change in their salience over time. Insight in the behavioural phenotype of very young children may advance our understanding about the gene-environment interaction in a particular syndrome. Genes provide only the starting points in more complicated, multi-directional epigenetic pathways and the emergence of behavioural phenotypes. As time goes on, pre-existing strengths

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become more pronounced compared to other, less intrinsically interesting or less practiced skills. As a result, areas of strength increase with age, whereas areas of weakness develop either slowly or not at all (Hodapp & Dykens, 2001). Additionally, the profile of strengths and weaknesses may shape the children's social environment and change the landscape of their social interactions with children and adults, at home and at school. From the first year onwards, differences in caregiver interactions and parenting style can be observed, adjusting their style of interaction in a number of ways to adapt to their children with DS (Glenn, Dayus, Cunningham, & Horgan, 2001; Slonims & McConachie, 2006). However the findings are not unequivocal (Gilmore, Cuskelly, Jobling, & Hayes, 2009). Although more studies are needed, our research provides some sense of how the behavioural phenotype in DS develops. A trisomy of chromosome 21 may predispose most children with DS to show an early occurring strength in imitation and weakness in language aptitude. Such small, beginning strength, in turn, subsequently may strengthen further due to some unspecified combination of environmental stimulation, motivation to partake of activities that use the imitation skill and increased practice in this skill. A cascade effect may be operating. Early imitative behaviour leads to better motor learning abilities and these abilities lead to increased daily living skills (Hodapp & Dykens, 2001).

Some implications of this study to research in preschoolers with other developmental disorders can be made. Researchers interested in autism have used DS as a prototypical case of mental retardation. By comparing the imitation performance of children with autism to that of children with DS, they have been able to identify deficits that are specific to autism rather than being shared by other conditions associated with mental disabilities (Knott, Lewis, & Williams, 1995; Knott, Lewis, & Williams, 2007; Libby et al., 1997; Nielsen, Suddendorf, & Dissanayake, 2006; Rogers, Hepburn, Stackhouse, & Wehner, 2003). For example, in two remarkable studies Knott and colleagues observed sibling pairs, including preschoolers with DS and autism, in a free play situation to investigate spontaneous imitation. The authors reported that children with autism imitated their siblings spontaneously less often overall than those with DS. In pairs including a child with DS, the disabled child maintains the interaction by imitating the sibling. However, in the pairs including a child with autism, the pattern was reversed. The rate of imitation increased in both types of dyad over time. This seems largely to be due to a large increase in rate of imitation by the siblings of children with autism (Knott et al., 1995, 2007). This kind of study design implicitly assumes that apart from being intellectually delayed children with DS are socially typical compared to typically developing children of comparable mental level. The results of present study revealed that this assumption may be false. There may be some areas of social cognition, including imitation, in which children with DS exhibit unique and specific advanced patterns of behaviour in relation to their mental capability. We suggest that children with NS-MR are more appropriate to serve as control group in autism imitation studies.

Some limitations of this study can be noticed. Children with DS and NS-MR were recruited from different settings. The findings are based on relatively small sample sizes and are only suggestive, not conclusive. Findings need to be replicated with a larger sample size. Since all children had language impairments, nonverbal mental age was used as reference criterion. Methodologically, the use of both verbal and nonverbal mental age as reference criteria seems more valuable. Finally, we did not rule out possible dual diagnoses, in particular autism and DS. The prevalence of autism among children with DS is substantially higher than in the general population (DiGuiseppi et al., 2010; Reilly, 2009).

Some implications of this study to the clinical practise of education and intervention in preschoolers with ID can be made. School and other services may prove more effective when considering characteristic behaviours of preschoolers with different retardation syndromes. Our finding of an imitation strength in DS is consistent with the general assumption that children with DS are highly sociable and that their social cognition is relatively intact. The strength in imitation skills, along with social strengths in general, may bode well for inclusive education. The predisposition of young children with DS to imitate in social situations and the tendency to use imitation in problem solving might support learning from more able partners, in particularly from typically developing peers. Education and rehabilitative programmes may involve the use of imitative strategies to improve the learning potential of young children with DS. Though, whether these imitative strategies truly support cognitive development in DS has recently been questioned (Dykens & Hodapp, 2001; Wishart, Willis, Cebula, & Pitcairn, 2007; Wright et al., 2006). Work by Wright and colleagues suggests that there may be important differences in how imitation is used by children with DS compared to typically developing children of comparable mental level. Children with DS applied imitative strategies to solve cognitive tasks in situations where more independent, cognitively driven strategies would be more appropriate and more successful. The authors suggest that this imitative bias may result from a predisposition to attend to social, rather than to non-social aspects of the world such as objects and tools (Wright et al., 2006). The latter suggestion may possibly explain why the children with DS in our study imitated the actions with objects at expected level and not above their nonverbal mental capability. Preschoolers with DS show bodily imitation abilities above their nonverbal mental capability and above their language abilities. We advocate to use this pre-existing bodily imitation strength to compensate for the weak language function. The imitation strength, along with visual-spatial strengths in general, may bode well for interventions such as sign language in children with DS (Dykens & Hodapp, 2001). Sign language is learned through gestural imitation. There is general agreement that the use of alternative communication systems such as sign language does not hinder the development of spoken language in DS but may actually promote its development (Martin et al., 2009). However, because not all preschoolers with DS did show this disorder's characteristic behaviour (sensitivity rate of 65 percent for bodily imitation strength, respectively 75–95 percent for language weakness), every child with DS will not benefit from this aetiology-based intervention strategy. Therefore, we suggest that imitation abilities of every young child with DS should be assessed in conjunction with mental and language assessments. This may allow a more personalised aetiology-based intervention planning in young children with DS.

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For further research we suggest a long-term cohort study of infants with DS to verify how the strength of imitation and weakness of language evolve over time. A longitudinal study may provide a better sense of how the good-imitator and poor-talker behavioural phenotype develops in DS and to what extent relatively advanced imitation skills influence the development of the overall level of intellectual functioning in these children.

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